United States Patent

Troccoli

[15] **3,702,372**

[45] **Nov. 7, 1972**

[54] MOLDED CORONA SHIELD FOR A HIGH VOLTAGE COUPLING

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[73] Assignee: **Thomas & Betts Corporation,** Elizabeth, N.J.

[22] Filed: **June 21, 1971**

[21] Appl. No.: **154,904**

[52] **U.S. Cl.** .....**174/73 S,** 174/73 R, 174/84 C

[51] **Int. Cl.** **H02g 15/08**

[58] **Field of Search** .....174/73 R, 73 SC, 84 R, 88 R, 174/94 R, 90; 339/276 R, 276 E

[56] **References Cited**

UNITED STATES PATENTS

3,558,799 1/1971 Lee .....174/73 R

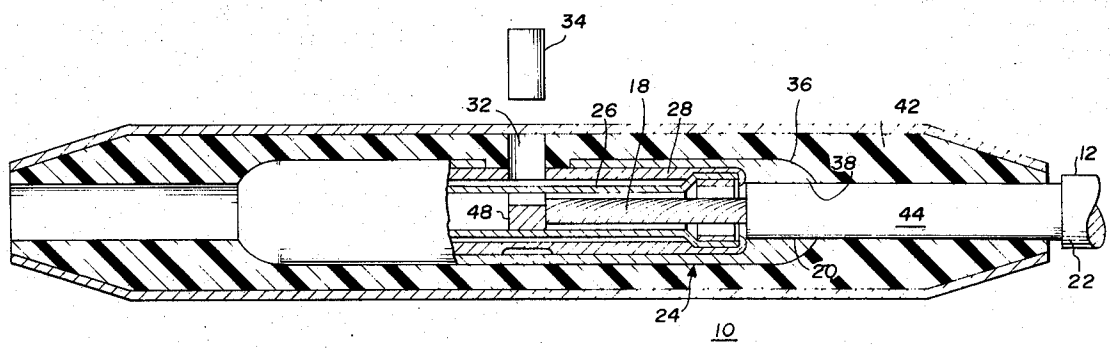
Primary Examiner—Darrell L. Clay

Attorney—David Teschner et al.

[57] **ABSTRACT**

A molded corona shield structure for a high voltage coupling, molded about the outer surface of the coupling and extending beyond the end thereof with an axial passage therethrough to permit entry of a conductor through such corona shield into the inner cavity of such coupling while making a tight fit with the exposed cable insulation. The corona shield is molded from a semi-conductive material composed of elastomeric materials containing a high percentage of highly conductive carbon black. Placed about the outer surface of the corona shield and the coupling is an insulating jacket so arranged as to form an intimate void free interface between the inner surface of the insulating jacket and the outer surface of the corona shield. A semi-conductive layer placed about the outer surface of the insulating jacket may be suitably joined to the semi-conductive outer layer of a cable by means of semi-conductive tape to finish the splice.

8 Claims, 4 Drawing Figures



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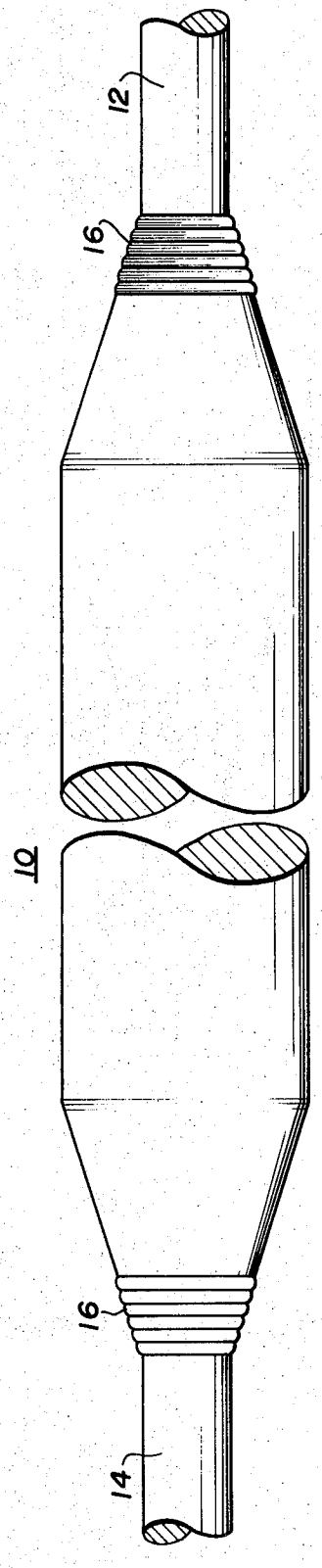

FIG. 1

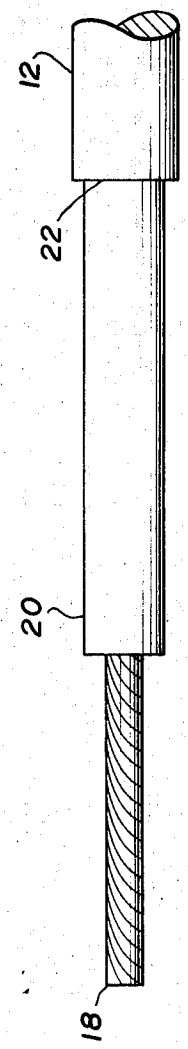

FIG. 2

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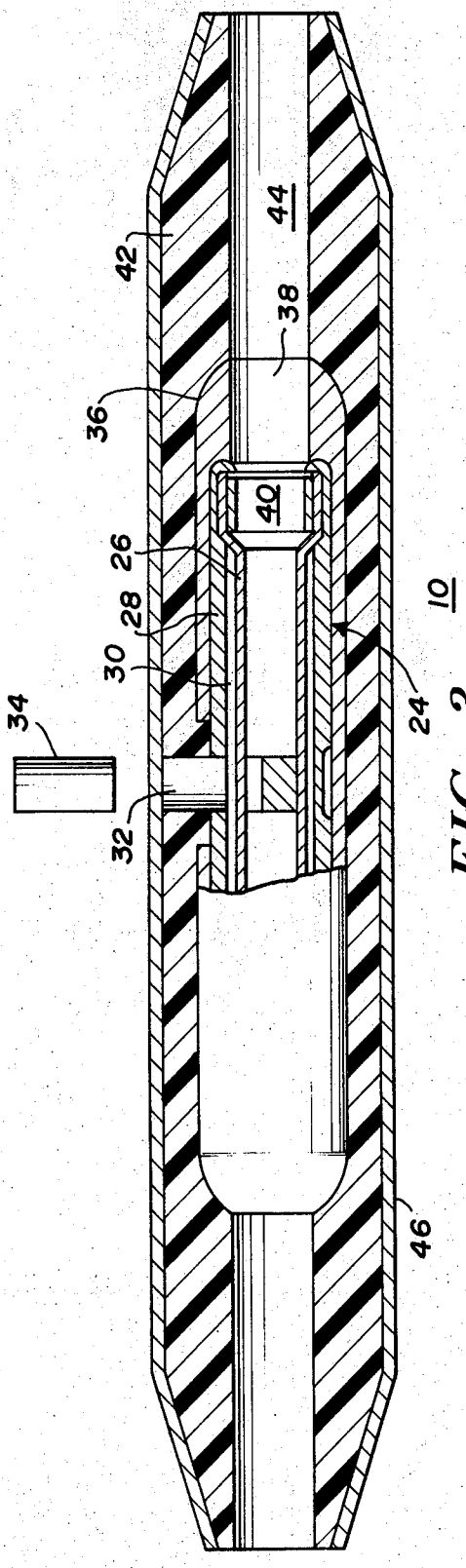
42
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38
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FIG. 3

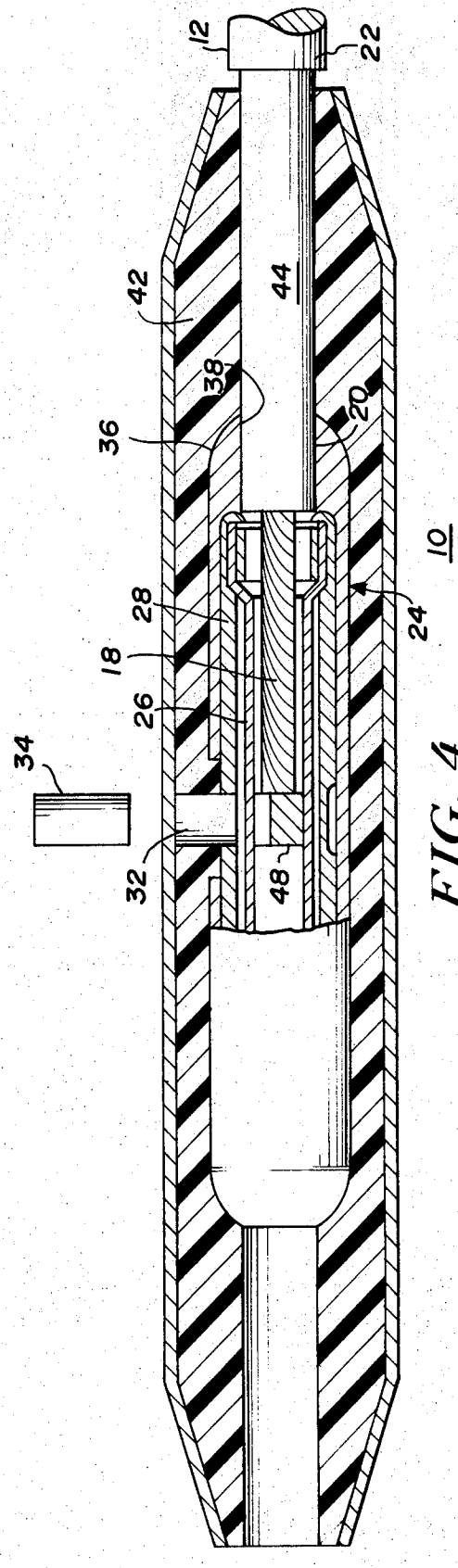
12
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FIG. 4

MOLDED CORONA SHIELD FOR A HIGH VOLTAGE COUPLING

CROSS REFERENCES TO RELATED APPLICATIONS

Reference is hereby made to other copending applications assigned to the assignee of the instant invention which describe certain details of the coupling and the device for achieving the crimping of the coupling to the conductors to be joined.

1. Method of Joining Concentric Members by Gilbert I. Addis and George M. Fairbanks, Ser. No. 148,707, filed June 1, 1971.

2. Differential Piston Pressure Coupler by George M. Fairbanks, Ser. No. 154,133 filed June 17, 1971.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention is directed to the field of splicing or coupling high voltage conductors for overhead or underground use. The invention is employed in the areas where it is desired to provide a corona free insulated splicer or coupler.

2. Description of the Prior Art

In U.S. Pat. No. 3,558,799, issued Jan. 26, 1971, by Asa Ren Lee entitled "Coupling," and assigned to the assignee of the instant invention, there is disclosed a preinsulated coupling for coupling together high voltage conductors providing a preinsulated corona-free splice therebetween. This device is provided with a corona shield made of a metallic plate which is joined to the conductor by means of an end plate and the entire assembly is joined to the coupling and supported thereabout by means of an insulating boot. The coupling of the conductor, by means of the end plate and metallic plate, to the conductor insulation places both the conductor, the conductor insulation, and the coupling insulation at the same potential. As a result, no potential exists across the air trapped within the coupling which could cause a corona discharge and destroy the joint. However, it has been found in practice that it is difficult at times to hold the exact desired position of the metallic corona shield and end plate during the molding operation of the insulating boot thereabout. Shifting of the position of the corona shield and end plate may result in a discontinuity in the path from conductor to insulation thereby destroying its purpose and thus allowing a high potential to exist across the trapped air and result in corona discharge destroying the joint.

SUMMARY OF THE INVENTION

The present invention seeks to overcome the difficulties noted above with respect to prior art corona shields for high voltage couplers by providing a corona shield molded upon the coupling sleeve ends such that its shape and position may be accurately controlled during the forming operation resulting in a continuous path between the current carrying central conductor and the conductor insulation to prevent applying a potential across any trapped air which could result in a corona discharge. The corona shield is molded of a semi-conductive material which may be an elastomeric material having a high concentration of highly conductive carbon black particles therein and then placing thereover

in such a manner as to provide a void free interface, an outer insulating jacket of suitable elastomeric materials. Finally a layer of semi-conductive material is placed upon the outer surface of the insulating jacket to provide for continuity, across the surface of the coupling, of the semi-conductive layer of the cable or conductor and thereby further minimize the possibility of corona discharge at the interruption caused by the presence of the coupling. It is therefore an object of this invention to provide an improved corona shield for a high voltage coupling.

It is another object of this invention to provide a molded corona shield for high voltage coupling.

It is still another object of this invention to provide an improved semi-conductive corona shield for high voltage coupling.

It is yet another object of this invention to provide a high voltage coupling having a corona shield thereon with an insulating jacket thereover having a void free interface therebetween.

Other objects and features of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principal of the invention, and the best mode which has been contemplated for carrying it out.

BRIEF DESCRIPTION OF THE DRAWING

In the drawings in which similar elements are given similar reference characters.

FIG. 1 is a side elevation of a coupling constructed in accordance with the concepts of the invention showing such coupling jointed to two conductors.

FIG. 2 is a side elevation of a portion of a conductor with which the coupling of FIG. 1 may be employed and showing various portions thereof removed so that the internal details of the conductor may be appreciated.

FIG. 3 is a side elevation of the coupling of FIG. 1, partially in section, so that the internal details of the coupling may be appreciated.

FIG. 4 is a side elevation of the coupling of FIG. 1, partially in section and having placed therein a portion of a conductor of the type shown in FIG. 2 so that the position of the various components of the conductor with respect to the coupling may be appreciated.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to FIG. 1 there is shown a coupling **10** constructed in accordance with the concepts of the invention and in accordance with the general teachings of the above cited Lee Patent. Coupling **10** has inserted in its opposite ends portions of conductors **12** and **14**. Each of these conductors **12** and **14**, as will be described below with reference to FIG. 2, have a semi-conductive outer layer as does the coupling **10** as will be better described with reference to FIG. 3. Semi-conductive tape **16** is applied at each end of the coupling **10** in order to join the semi-conductive layer of the coupling **10** to the semi-conductive layers of the individual conductors **12** and **14**.

Turning now to FIG. 2 the component portions of a typical conductor **12** are shown. A central portion of the conductor **12** is a current carrying conductor which

may be formed of solid or stranded copper, aluminum or similar metal. Placed about the metallic conductor 18, but not visible in FIG. 2 because the same has been removed therefrom, is a semi-conductive layer. Placed about the semi-conductive layer is a cable insulator 20 made of solid dielectric materials such as cross-linked polyethylene, low-density polyethylene and ethylene-propylene rubber. Finally, placed about the cable insulation 20 is a semi-conductive shield 22 which may take the form of a layer, tape or paint and is generally in the form of a carrier having a high concentration of highly conductive carbon black particles therein.

In order to employ the coupling 10 of FIG. 1, a conductor such as 12 will be prepared in the manner shown in FIG. 2, that is, with a length of the central conductor 18 fully exposed, then a length of the cable insulation 20 fully exposed and finally the remaining portion of the cable having all of the layers intact. As will be described below, with reference to FIG. 4, all of the exposed conductor portion 18 is entered within the crimp sleeve of coupling 10. The cable insulation portion 20 fills the remainder of the coupling 10 and extends beyond the end thereof. The semi-conductive portion 22 remains entirely outside of the coupling 10.

Turning now to FIG. 3 the inner details of the coupling 10 of FIG. 1 may be appreciated. Coupling 10 consists of a crimp sleeve 24 made up of an inner deformable, hollow tube 26 concentrically mounted with an outer non-deformable concentric hollow tube 28. Inner sleeve 26 and outer sleeve 28 are formed in such a manner as to provide an annular recess 30 therebetween. As is fully described in the above cited U.S. Patent a suitable material is introduced via the aperture 32 into the recess 30 by which inner sleeve 26 is caused to deform to grasp the ends of conductors placed therein. Once the deforming operation of the inner sleeve 26 has been completed a plug such as 34 will be inserted into the aperture 32 to seal the aperture 32 and thus assure the continuity and integrity of the overall coupling 10. The ends of the inner sleeve 26 and the outer sleeve 28 are joined in such a manner as to provide a seal and thus prevent loss of the material being entered through the aperture 32 into the recess 30. The techniques for causing the joinder of the ends of the inner sleeve 26 and the outer sleeve 28 are more fully set forth and claimed in copending application No. 1 set forth above. A device for introducing the compressing material into the aperture 32 is fully described and claimed in application No. 2 recited above.

About the outer surface of the outer sleeve 28 is molded the corona shield 36 which is made of a semi-conductive material which may be an elastomeric material containing a high concentration of highly conductive carbon black particles. Corona shield 36 is molded about the outer surface of the outer sleeve 28 in such a manner that it extends beyond the ends thereof and thus will be caused to contact the conductor 12 as the same is being inserted within the crimp sleeve 24. This molding operation is accomplished by press molding in a closed cavity to vulcanize the corona shield 36 material in the desired position and shape. The corona shield 36 is generally tapered towards the conductor 12 at its end remote from the crimp sleeve 24 so as to provide a gradual transition between the larger diameter of the crimp sleeve 24 and the smaller diameter of the cable 12 insulation portion 20 minimizing the potential gradient on the insulating jacket 42. Axial passage 38 extends through the corona shield 36 to permit entrance of conductor 12 into the crimp sleeve 24. To prevent destruction of the ends of the crimp sleeve 24 during the crimping operation as generally set forth above, force rings 40 are employed at each end of the crimp sleeve 24. This will prevent deformation of the crimp sleeve 24 at the ends which could permit the escape of the crimp material of the corona shields 36 and outer sleeve 30.

Molded to the outer surface, in a manner such as to form a void free interface, is an insulating jacket 42 composed of an elastomeric material. The outer insulating jacket 42 is also molded using press molding techniques in a closed cavity. By control of the mold design, the materials employed and the operating parameters the desired void free interface can be achieved. Insulating jacket 42 has axial passages 44 therethrough such passages being sufficient to permit entry of a cable, such as 12, into the crimp sleeve 24 and yet make a close intimate joint with the cable insulation 20 of cable 12. Finally, the outer surface of the insulating jacket 42 is covered with a semi-conductive material such as 46 to permit the continuity of the semi-conductive shield of the cables themselves across the coupling 10. As was described above with reference to FIG. 1, a semi-conductive tape is used to form the continuity between the semi-conductive material 46 of the coupling 10 and semi-conductive shields 22 of the cables 12 and 14.

Turning now to FIG. 4 the coupling 10 of FIG. 3 is shown with a length of conductor 12 inserted therein. As is shown, conductor 12 is inserted in such a manner that the bare conductor portion 18 is caused to fully enter crimp sleeve 24. A wire stop 48 is placed approximately midway of the passage within the inner sleeve 26 to limit the insertion of the conductor 12 thus assuring that crimp sleeve 24 will adequately grasp each of the conductors 12 and 14. A portion of the cable insulation 20 will be contacted by the corona shield 36 as the cable insulation portion 20 of the conductor 12 passes through the aperture 38 of the corona shield 36. The remaining portion of the cable insulation 20 of the conductor 12 will be in contact with the inner surface of the outer insulating jacket 42. With the conductor such as 12 in place and the crimp sleeve 24 crimped to the central current carrying conductor portion 18, a conductive path is established between the conductor portion 18, the sleeve 24, the corona shield 36 to the conductor insulation portion 20. Thus each of these components are maintained at the same potential, namely, that of the conductor portion 18. Any air trapped at the mouth of crimp sleeve 24, that is where inner sleeve 26 and outer sleeve 28 are joined, will have a zero potential thereacross and thus eliminate the possibility of a corona discharge. The axial passages 38 and 44 through the corona shield 36 and the outer jacket 42 respectively are so dimensioned that a relatively tight fit is accomplished between the component portions of the conductor 12 and the adjoining walls of the corona shield 36 and the insulating jacket 42. In this manner, the leakage of water into the coupling 10 is minimized and also precludes electrical creep failure. Further, the

rather tight fit between the component portions and the conductor 12 itself limit the amount of air originally present when the coupling 10 is assembled to the conductors 12 and 14.

The sequence of operations for installing the coupling 10 may now be appreciated. Firstly, a length of conductor, such as 12, is stripped in the manner shown in FIG. 2, that is, firstly a portion of the semi-conductive shield 22 is removed thereby exposing the cable insulation layer 20. Then a portion of the cable insulation 20 is removed to expose semi-conductive layer which when removed exposes the inner current carrying conductor 18. Conductor 12 thus prepared is then inserted within the aperture 44 of the insulating jacket 42 and forced forward thus entered through the aperture 38 in the corona shield 36 and thence within the crimp sleeve 24 until contact is made with the wire stop 48. A second conductor, such as 14, prepared as above is inserted within the coupling 10 as above described. A suitable filling device such as described in the above referenced application No. 2 is then connected with its nozzle entering into aperture 32 to permit the entrance of a compressing material into the interspace 30 between the inner sleeve 26 and the outer sleeve 28 to cause deformation of the inner sleeve 26 thus grasping the conductive portion 18 of the conductors 12 and 14. The nozzle is then removed and a plug 34 placed within the aperture 32 to seal the overall coupling 10 and guarantee the integrity of the entire unit. The taping of the coupling 10 ends is completed and then the assembled cables 12, 14 and coupling 10 cable may be placed within the cable vault, conduit, or hung overhead as may be desired.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a coupling for joining a first member to a second member comprising a rigid hollow outer member and a deformable hollow inner member for deformable interengagement with a first member and a second member inserted within said inner member the improvement comprising: a molded corona shield about at least a first end of said outer member; said corona shield molded from a semi-conductive material; and an insulating jacket about said corona shield.

2. A coupling as defined in claim 1 wherein said corona shield is comprised of two similar parts, one each placed about each of the first and second ends of said outer member and said insulating jacket extends about both of said corona shield parts.

3. A coupling as defined in claim 2, wherein the juncture between said corona shield parts and said insulating jacket is void free.

4. A coupling as defined in claim 2, wherein said corona shield parts each extend beyond their associated ends of said outer member.

5. A coupling as defined in claim 2, wherein each of said corona shield portions has an axial passage therethrough.

6. A coupling as defined in claim 1 wherein the juncture between said corona shield and said insulating jacket is void free.

7. A coupling as defined in claim 1, wherein said corona shield extends beyond the associated end of said outer member.

8. A coupling as defined in claim 1, wherein said corona shield has an axial passage therethrough.

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